SURFACE MORPHOLOGY AND OPTICAL PROPERTIES OF COPPER NITRIDE THIN FILM SYNTHESIZED BY DC SPUTTERING

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Specially dedicated to

My beloved husband, En. Hanezan bin Hanaffi

For supporting and encouraging me to believe in myself

My parents, En. Ma'ajih bin Ismail and Pn. Narizan binti Mohd

My parents in law, En. Hanaffi bin Hj. Kesman and Pn. Azizah binti Hj. Muhamad

A strong and gentle soul who taught me to trust in Allah, believe in hard work and that so much could be done with little

My siblings from both families

Mohd Mustakim and Siti Nursabariah, Nurul Shahirah, Nurul Shahizzat

Fakhrul Nazhi and Farah Wahida, Farhan and Siti Suhana, Mohd Hanirulhaidi, Mohd Nurafendi, Rafidi, Rafidah

For understanding and supporting me to achieve my dreams

and

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You are my strength

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ABSTRACT

The purpose of this research is to study the surface morphology and optical properties of copper nitride thin films. Copper nitride thin films were deposited on corning glass substrates by using DC sputtering technique. Five samples were prepared with five different deposition time to obtain samples of different thicknesses. Ellipsometer was used to measure thickness and refractive index. The surface morphology images were obtained by using Atomic Force Microscopy (AFM). Both transmission spectra and photoluminescence spectrum were obtained from UV-Vis-NIR spectrophotometer and Photoluminescence spectrometer, respectively. The films obtained were yellow to reddish-brown depending on increasing deposition time. The thickness of the samples increased as the deposition time increased. Thicknesses of films, d obtained were in range of 1092.38 nm to 1331.03 nm. Refractive index decreased as deposition times increased. The Atomic Force Microscopy images showed that the films were a smooth morphology and were seen like pyramidal islands when deposition time increased. Transparency of copper nitride thin film was very low in the visible region, but it slowly increased in the infrared range. The absorption coefficient, α of copper nitride thin films increased with increasing of photon energy. The average optical band gap energy, E_g obtained in range of 1.56 eV to 2.06 eV. The best emission peak for maximum intensity was about 380 nm obtained in photoluminescence emission for all samples, which refer to ultra-violet light in visible light region of electromagnetic spectrum.

ABSTRAK

Penyelidikan ini bertujuan untuk mengkaji permukaan morfologi dan sifat optik saput tipis kuprum nitrida. Kuprum nitrida telah dipendapkan pada permukaan substrat kaca dengan menggunakan kaedah percikan arus terus. Lima sampel telah disediakan pada lima masa pemendapan yang berbeza untuk menghasilkan sampel yang mempunyai ketebalan yang berbeza. Ellipsometer digunakan untuk mengukur ketebalan dan indeks biasan saput tipis. Imej 3D morfologi bagi semua sampel diperoleh daripada *Atomic Force Microscopy (AFM)*. Kadar penghantaran sampel diukur dengan menggunakan *UV-Vis-NIR Spectrophotometer* dan analisis foto luminescence diukur menggunakan *Photoluminescence Spectrometer*. Saput tipis yang terhasil adalah berwarna coklat kemerahan bergantung kepada masa pemendapan. Ketebalan sampel bertambah apabila masa pemendapan bertambah. Ketebalan filem, *d* yang terhasil dengan julat antara 1092.38 nm hingga 1331.03 nm. Indeks biasan adalah berkurang apabila ketebalan sampel bertambah. Imej yang dihasilkan oleh AFM adalah permukaan morfologi seragam dan kelihatan seperti piramid apabila masa pemendapan bertambah. Kadar penghantaran kuprum nitrida adalah rendah dalam cahaya nampak, tetapi mula meningkat dalam julat sinar merah. Pekali penyerapan, α bertambah apabila tenaga fonon bertambah. Purata jurang tenaga optik, E_g adalah antara julat 1.56 eV hingga 2.06 eV. Panjang gelombang puncak maksimum terbaik bagi pancaran foto luminescence adalah 380 nm yang merujuk kepada warna *ultra-violet* berdasarkan kepada spektrum cahaya nampak.